OBSERVATIONS ON THE LIFE HISTORY AND HABITS OF THE STAG BEETLE *LAMPRIMA AURATA* (LATREILLE) (COLEOPTERA: LUCANIDAE) IN TASMANIA

Simon Fearn

11 Osberg St, The Gap, Brisbane, Qld 4061

Abstract

Aspects of the life history of *Lamprima aurata* (Latreille) are described, including oviposition, larval and pupal behaviour, larval food sources, adult food plants, feeding behaviour and male territoriality. Characteristics of *L. aurata* populations are discussed, such as size range, sex ratios and factors that may regulate population densities.

Introduction

Lamprima aurata (Latreille) is common and widespread in Tasmania, mainly in the drier eastern half of the State in coastal habitats and dry woodland. In the higher rainfall, densely forested western half of the island, *L. aurata* appears to be a coastal species, with specimens collected by the author as far west as Stanley on the north-west coast. *L. aurata* is recorded also from some of the larger islands of the Furneaux Group, eastern Bass Strait, with specimens in the Queen Victoria Museum, Launceston, from Flinders I. In addition, the author collected a single female on Mt Chappell Is.

Lamprima aurata is common in Victoria and the tablelands of New South Wales (Moore 1986) but scarce in South Australia (Matthews 1984). It is replaced by the closely related *L. latreillii* (Macleay) from coastal New South Wales to north Queensland (Moore 1986). In the author's experience, *L. aurata* does not occur in habitats characterised by closed canopies with wet and/or shaded substrates (temperate rainforests and undisturbed wet sclerophyll forests) or in alpine regions. Areas of human disturbance through forestry or farming activities can be rapidly colonised by *L. aurata* due to the abundance of residual stumps and root systems which provide the larval food source. The following notes describe the behaviour of the various life stages in the Launceston area, from observations made from 1981 to 1990.

Oviposition and larval food sources

Oviposition generally takes place below ground level. Females tunnel into the soil at the bases of stumps, logs and other timber that is partially or wholly buried. C. Spencer (pers. comm.) discovered a female constructing a brood chamber alongside a partially buried eucalypt railroad sleeper. A tunnel 40 mm long and 15 mm wide had been excavated to a depth of 30 mm below soil alongside the sleeper. Three dirty-white eggs, 2 mm x 1 mm in size, had been laid in the 10 mm deep decomposed outer layer of the sleeper. Each egg was deposited in its own small chamber (4 mm x 3 mm) constructed by the female and composed of flakes of decayed wood at the bottom of the tunnel. The female spent 90 mins filling in the tunnel.

The female emerged from the tunnel and, by bracing on its hind and mid legs, loosened soil with the forelegs and mandibles, scraping it backwards into a pile in front of the tunnel entrance. When enough soil had been gathered, the female pushed the earth forwards into the tunnel, remaining underground for 2 mins at a time before emerging to repeat the process. When the tunnel was full the female remained motionless on the ground for several minutes before flying away.

Oviposition above ground level is rare, with only three examples known to the author. One female was observed to tunnel into the side of a large stump of *Acacia dealbata* Link. It alighted on the stump 0.4 m above the ground and located a crack in the hard bark and outer wood. The interior of the stump consisted of soft, pulpy wood which the beetle penetrated, using its forelegs. On another occasion, 24 adults were collected from pupal chambers in a dead black wattle *Acacia mearnsii* De Wild. in dry scrubland. The diameter of the tree trunk was 0.4 m and it had come to rest 0.6 m above the ground after being blown over. Infestation had taken place in the soft, pulpy interior. In the third example, larval infestation was discovered in dry eucalypt forest in a large eucalypt (trunk diameter 1.05 m) that had blown over. Larval galleries were situated in a thin layer of white, pulpy wood, 30 mm deep, immediately beneath the bark. In the latter two examples, oviposition and subsequent larval infestation had taken place in the log itself and not via the roots of the fallen trees.

Dead and decaying tree root systems are the major larval food source of *L. aurata* in Tasmania, with both native and ornamental species infested. The author has found larvae in the dead root systems of *Acacia, Banksia, Eucalyptus, Populus, Salix* and *Virgilia*, plus *Pinus radiata*. Larvae and adults (within pupal chambers) have been collected from buried wooden framing around house foundations, fence posts, telegraph poles, logs partially buried in soil and sawdust heaps in abandoned rural sawmills.

Larval behaviour and pupation

Larvae hatching from eggs deposited at the base or underside of stumps appear to bore outwards along the underside of major roots, usually to a distance of 1-1.5 m by the time the pupal chamber is constructed, depending on the length and diameter of the root. Sometimes, if thick bark is still present on the stump, larvae will bore upwards from below soil level, pupating under the bark 15-30 cm above ground.

Larvae which develop in fence posts and telegraph poles bore either around the perimeter of the wood or up or down, depending on the length of timber below ground level. Larvae bore in a more or less straight line, packing the tunnel behind them with faecal material and wood scrapings.

The last larval instar, 30-35 mm long, begins to construct a pupal chamber in September. This is an oval cell, 20-30 mm long, chewed out of the wood. In most cases the chamber is constructed just beneath the outer surface of the root, with a thin layer of wood covering it to facilitate adult emergence. Both ends are padded with tightly packed strips of wood, 4-15 mm long. The other most common type of pupal chamber (usually on thin roots) is constructed on the outer surface of a root and is built partially out into the soil. In this case, one wall of the chamber is the root and the other is constructed entirely from strips of wood.

Construction of the pupal chamber and duration of the prepupal and pupal stages appears to take several months as fully hardened and coloured adults are not found in pupal chambers until late February or April. While one generation of adults is dying, those of the next generation are fully formed within pupal chambers, where they remain for 9-10 months until the following summer.

The time taken to develop from the late instar larva to adult emergence is at least 2 years, so the entire cycle from egg to emerging adult may take at least 3 years in Tasmania.

Adult emergence, food plants and feeding behaviour

During the course of this study, emergence of *L. aurata* adults took place consistently in the first 2 weeks of December each year and appeared to be initiated by temperature. Emergence took place on hot, windless days, with both sexes emerging in late morning between approximately 10.30 and noon. Adults tunnel out of the pupal chamber and up through the soil, scrambling around for a few minutes before flying away. No attempts at copulation were observed on the ground before flight.

The most favoured adult food trees in Tasmania are *Eucalyptus viminalis* Labill., *E. globulus* Labill. and *E. pauciflora* Sieb. ex Spreng. Six females and 13 males were collected feeding on a large clump of *Lomandra longifolia* Labill. on the east coast of Tasmania. Mating pairs have been collected on blossom of *Leptospermum* and *Hakea teretifolia* (Salis) J. Britt. One male was observed feeding on an overripe strawberry in Launceston and adults found feeding on an ornamental *Photina* sp.

Adults feed on the last 50-100 mm of the uppermost shoots on host tees, males cutting them off at about 3 mm diameter. The mandibles of females are small and weak and they appear to rely on males to open up the food resource; they have not been observed cutting the shoots. At the end of the cut stem single males or mating pairs feed on the exudates of phloem and xylem. Most trees suffer no serious damage from this feeding, but some that are heavily infested for several years begin to take on a box shape from the annual tip pruning.

Young trees, 2-10 m in height appear to be preferred to large mature trees and of these only certain trees appear to be selected. In December 1982-83, over 400 adults were collected on 6 saplings of *Eucalyptus viminalis* in approximately 2 ha of open *Acacia* and *Eucalyptus* scrub in Trevallyn, Launceston. Many other saplings of *E. viminalis* were present but in both years only the same 6 trees were used. By the summer of 1984 two of these trees had been cut down and only 2 of the remaining 4 continued to attract beetles between 1984 and 1990. No obvious differences were discernible between favoured and non-favoured trees.

In 1977 and 1985, a *Photina* sp. tree in a Launceston garden was visited by dozens of *L. aurata* but not in intervening years, although adults were common and present each year on nearby specimens of *E. globulus*. These suggest that *L. aurata* may be able to detect physiological differences in trees that make them more attractive as a food source.

Monteith (1992) described similar behaviour in the dynastid *Xylotrupes gideon* L., feeding on poinciana trees (*Delonix regia*) in Brisbane, Queensland. Particular trees became very attractive to the beetles, with large numbers congregating to feed on the bark of young shoots. Norris (1991) noted many examples of insect resistant plants within a given species but the reasons for resistance are not readily discernible.

Copulation and territorial behaviour

Adult male *L. aurata* are territorial and once alighted on a suitable shoot they defend it vigorously, attacking other males with their large mandibles. These contests normally last less than a minute, with the larger male winning. On several occasions, large males lifted a smaller one from a twig by a leg and threw it off. More often, the weaker male retreats backwards down the stem to try elsewhere. In heavily infested trees these contests result in a large number of defeated males falling to the ground.

Copulation occurs at the cut shoot tips. Females are rarely seen without an attendant male and their apparent inability to sever shoots indicates that females may be attracted to cut shoot tips provided by the males, further indicated by the vigorous defence of cut shoot tips by males.

Size range and sex ratio

Adult Tasmanian *L. aurata* vary considerably in size, particularly males. Most males are 21-28 mm long, the largest examined being 34 mm long (including mandibles) and 14 mm wide, the smallest 15 mm x 6 mm. Most females are 19-22 mm long, the largest examined being 25 mm long x 10 mm wide, the smallest 14 mm long.

There is little variation in relative size of mandibles in males, remaining in proportion to body size. This may be due to the functional role played by the mandibles in cutting shoot tips and defending them.

In field collected samples, males outnumbered females by approximately 3 to 1 (Table 1).

Table 1. Numbers of males and females in samples of *L. aurata*.

DATE	LOCATION	MALES	FEMALES	TOTAL
14.xii.1982	Trevallyn, Launceston	172	60	232
23.xii.1982	Beechford, North coast	25	7	32
18.xii.1983	Trevallyn, Launceston	170	50	220
27.i.1984	Greens Beach, North coast	50	28	78
1.i.1985	Beechford, North coast	36	9	45
13.i.1985	Greens Beach, North coast	26	19	45
26.i.1986	Chain of Lagoons coastal reserve, East coast	31	4	35
TOTALS		510	177	687

Population densities

Lamprima aurata appears to be a species that thrives through human alteration of habitats. Of hundreds of larval food sources examined, all but two resulted from human activity. It is likely that the abundance and distribution of *L. aurata* in Tasmania has increased since the arrival of Europeans. From the author's observations, it is apparent that *L. aurata* prefers well drained sites with maximum exposure to solar radiation., particularly in relation to larval food resources. No evidence of this species has been found in undisturbed closed forest and in cooler, higher rainfall districts it appears to be confined to areas disturbed by forestry or farming activity.

Forestry activities have been extensive in Tasmania for many years and clear fell operations in particular provide abundant larval food resources through stumps, logs and other timber that are left behind. This is enhanced in some cases by the replanting of eucalypt species attractive to the adults. In forestry plantations where conditions were ideal for *L. aurata* (abundant residual timber), thousands of adults were active in the young trees. Any land clearing that does not include removal of stumps and logs provides an opportunity for colonisation by *L. aurata.*

In some areas *L. aurata* does not become established in large numbers despite the presence of apparently suitable larval food sources. This may be due to an absence of suitable adult food trees, implying that adults do not fly far either in search of suitable food trees after emergence or for suitable oviposition sites after mating.

In addition to land clearance, timber in service, such as fence posts and untreated telegraph poles throughout rural and urban areas, have been utilised by *L. aurata*. High fire frequencies around towns and coastal shack developments also provide abundant residual timber and root systems.

Larval food resources in any given area appear to be a major factor governing population density. In December of 1982 and 1983, over 450 specimens of

L. aurata were collected and many more observed, in an area of open scrub and grazing land at Trevallyn, Launceston, where high voltage electric towers are located and trees (mainly *Acacia mearnsii*) below and around the towers were poisoned. Dead stumps and root systems provided an abundant larval food source. Peak years for *L. aurata* in this area were 1982 and 1983; between 1984 and 1990, no more than 20-40 adults were observed each season and their average size also decreased. This decline in number and size appears to be a result of the near exhaustion of the larval food source. Excavated root systems and lower trunks of the dead trees and stumps were composed mainly of frass, with little or no intact wood. Larval resource limitations therefore may cause populations of *L. aurata* to fluctuate widely over time and space.

Acknowledgments

My thanks to Dr Barry Moore (CSIRO, Canberra) for identifying the beetle and Dr Bob Green (formerly of Queen Victoria Museum, Launceston), for access to the Museum's collections. Special thanks to Chris Spencer (Liffey, Tasmania) for providing his detailed oviposition observations, Stuart Von See and Andrew Walker for many hours of field assistance and companionship and Maria Hennessy for typing the manuscript.

References

MATTHEWS, E.G. 1984. *A guide to the beetles of South Australia. Part 3, Polyphaga: Eucinetoidea, Dascilloidea and Scarabaeoidea.* South Australian Museum Adelaide; 60 pp.

MONTEITH, G.B. 1992. Rhinoceros beetles. *Queensland Museum Information Pamphlet* No. 58.

MOORE, B.P. 1986. *A guide to the beetles of South-Eastern Australia* Fascicle 7, pp 101-116. Australian Entomological Press, Sydney.

NORRIS, K.R. 1991. General biology, *in*: CSIRO Division of Entomology (ed.), *The insects of Australia*, Vol. 1. Melbourne University Press.